Reconnaissance survey of drainages at the proposed University of Hawai`i West O`ahu Campus, Kapolei, `Ewa District, O`ahu[1]

September 19, 2005 ***Draft*** *AECOS* No. 1099

Susan Burr and Eric Guinther
AECOS, Inc.
45-939 Kamehameha Highway, Room 104
Kaneohe, Hawai`i 96744
Phone: (808) 234-7770 Fax: (808) 234-7775 Email: aecos@aecos.com

Introduction

The University of Hawai`i is planning to build a West O`ahu Campus on former sugar cane land at East Kapolei (Figure 1). The proposed campus site is bounded by Farrington Highway, the proposed North-South Road, former sugar cane lands, and Kapolei (Figure 2). The project site encompasses a total of 500 acres or 202 hectares (TMK: 9-1-016:120, 127, 129). Because of the topography in this area, a number of drainage improvements are planned to alleviate potential flooding problems resulting from development of the campus. This report presents the results of a reconnaissance survey of the area drainages conducted by *AECOS*, Inc. Char & Associates (2003) assessed the botanical resources on the proposed campus site in 2003. Bruner (2005) conducted an avifaunal and feral mammal field survey in 2005.

Methods

On August 18, 2005, *AECOS* biologists conducted a reconnaissance survey of Hunehune and Kalo`i gulches in the project area to include identification of aquatic flora and fauna and riparian vegetation. None of the area drainages had flowing water in them at the time of our survey so water samples were not collected. The primary survey method involved driving around the project area to various points on the drainages that could be reached via existing roads.

[1] This report was prepared for use by Engineering Concepts in preparing permit applications for drainageway improvements at the West Oahu Campus site and will become part of the public record.

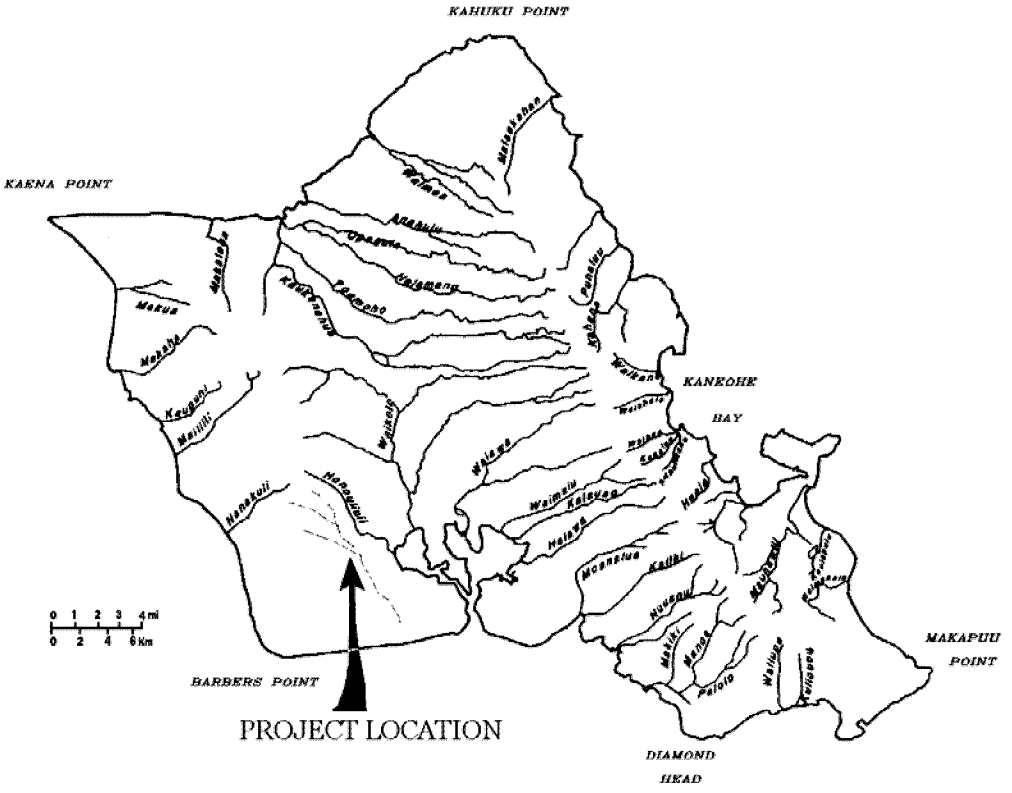

Figure 1. Project location on the Island of O`ahu.

Environment Description

The `Ewa Plain is a broad, gently undulating feature on the south side of O`ahu extending from West Loch of Pearl Harbor to Barbers Point and north to . The plain represents an ancient reef formation that was submerged during a previous high stand of the sea; the plain is now a mostly limestone platform with alluvium eroded from the nearby Waianae mountain covering much of the northern or interior part. Runoff mostly infiltrates to groundwater well below the surface rather than pooling in low areas for any length of time. Early Hawaiian occupation of the `Ewa Plain was concentrated near the shore because the area is mostly dry and without permanent streams. In the mid-1800s cattle ranches operated in the area. The Ewa Plantation was started in 1890, by which time the OR&L was running from Honolulu through `Aiea to `Ewa, allowing the plantation to ship product to market in Honolulu or the docks at Honolulu Harbor (Char and Balakrishnan, 1979). In 1893 until the 1920s, a sisal (*Agave sisalana*) plantation was started around the town of Sisal, then located close to Pu`u o Kapolei (Neal, 1965).

By the 1930s nearly all of the `Ewa Plain was covered by sugar cane (Ewa Plantation, Honouliuli), small vegetable farms, poultry farms, and piggeries. Lands not so

occupied became part of sizable military bases and facilities (Iroquois Point Navy Housing, West Loch Naval Magazine, Barbers Point NAS), and later, an industrial park (started in 1959) with a small barge harbor expanded in 1985 to a deep draft ship harbor. Most of the agricultural uses have since been abandoned, and the land is being converted to suburban housing and urban commercial district as the center of a "second city" on O`ahu called Kapolei.

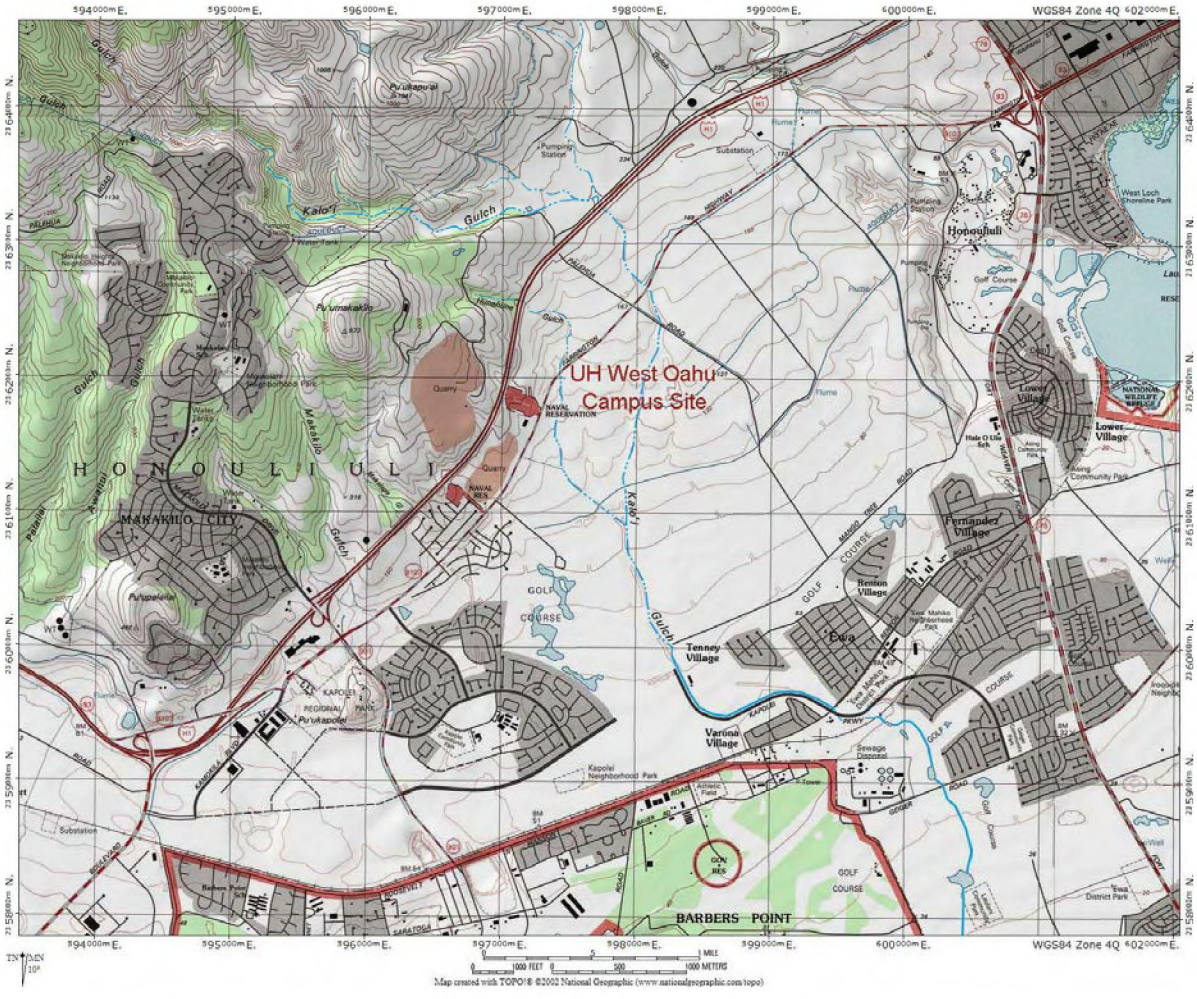

Figure 2. The project location is bounded by Farrington Highway, the proposed North-South Road, former sugar cane lands, and Kapolei.

Numerous gulches dissect the broad flank of the Waianae mountain to the north of the `Ewa Plain. These contain intermittent streams that tend to disappear into broad swales on the plain. Water flow during infrequent runoff events is now directed through man-made ditches, swales, or detention features.

Kalo`i Gulch arises along the southeast end of the Wai`anae Range of leeward O`ahu from several gulches located to the north of Pu`u Makakilo (Figure 2) to Pu`u Ku`ua on the east and Pu`u Manawahua on the west. Other "streams" further west of Pu`u Manawahua, such a Makalapa, Makakilo, and Hunehune eventually flow towards Kalo`i on the plain. Hunehune Gulch drains the eastern slope of Pu`u Makakilo (including a quarry on the southeast face), feeding into Kalo`i on the `Ewa Plain after passing through the campus site.

The natural drainage on the `Ewa Plain is mostly infiltrated rather than discharged to the ocean. Kalo`i and Hunehune are not exceptions to this pattern. Because Kalo`i and Hunehune gulches are not perennial streams, they are not listed in the Hawaii Stream Assessment (Hawaii Cooperative Park Service Unit, 1990).

The stream bed of Kalo`i Gulch is natural appearing upstream of the H-1 Highway (Figure 3a), although some branches are confined by man-made berms. Various concrete culverts occur where roads cross the narrow channel (Figure 3b). For a distance of 0.8 km (0.5 mile) or so downstream from the H-1 Highway the stream bed of Kalo`i Gulch is rock and boulder filled, lying well below the elevation of the surrounding land in a man-made channel. Near vertical banks lined with *koa haole* (*Leucaena leucocephala*) separate the ditch from adjacent agriculture fields. In places, the channel is overgrown with Guinea grass (*Panicum maximum*).

Within this segment downstream from Farrington Highway, "Kalo`i Gulch" is a ditch confining the occasional freshets (flood flows) that once flowed across the `Ewa Plain in the vicinity of the Ewa Plantation and the plantation villages. This ditch was used to convey irrigation water from pumps and reservoirs to sugar cane fields in the lowlands northwest of `Ewa Beach (*AECOS*, 1992). However, this irrigation system is no longer in operation today. The ditch is presumably dry a majority of the time, although small isolated pools may remain in low areas after flood flows.

In the vicinity of the Ewa Villages, the stream bed is confined between high berms and/or concrete walls (Figures 4a and 4b). Near the coast, the ditch is directed westward then again southward, opening onto *kiawe* (*Prosopis pallida*) forest about 0.6 km (0.38 mile) inland from the shore at One`ula Beach Park. Outlets are present on both sides of the park; however, these outlets rarely contain flowing water.

In more recent years, this drainage has been dug out to provide flood relief throughout the `Ewa Villages housing projects. One detention basin is located at the west end of Mango Tree Road near the Ewa Villages Golf Course and this is presently the direct recipient of freshet flows from Hunehune and Kalo`i gulches. Other detention areas created to receive floodwaters in this part of the `Ewa Plain are broad swales occupied

Figure 3a. (upper). Kalo`i Gulch fork upstream from construction access road above H-1. Figure 3b (lower). Kalo`i channel as it appears passing through the UH campus site.

Figure 4a (upper). Detention basin wall of Kalo`i looking upstream from Renton Road Bridge. Figure 4b (lower). Kalo`i Gulch looking upstream at left bank and accumulated water below Kapolei Parkway Bridge near Renton Road.

by Kapolei Golf Course (drainage from Makakilo Gulch and Makakilo City) and Coral Creek Golf Course (drainage from Kalo`i) after detention area off Mango Tree Rd.).

Prior to development of sugar cane on the `Ewa Plain, Kalo`i Gulch probably drained towards the area now occupied by Barbers Point Naval Air Station (BPNAS; AECOS, 1992). It is doubtful that any specific stream outlet existed. Rarely, if at all, would water flowing across the `Ewa Plain from rains in the uplands actually reach the shore as surface flow. Thus, the stream channel which today passes through the proposed campus site was originally been constructed to divert flow away from the airfield at BPNAS during the 1940s, or to serve growing irrigation needs when OSCo sugar cane fields were expanded into former military areas east of BPNAS in the 1950s. In any event, all of the "stream" through and downstream of the proposed campus site is an irrigation structure of earthen materials with some flood control function

Vegetation

A check-list of plants noted from each of the drainages visited during the survey is provided as Table 1.

Table 1. Listing of plants (flora) observed in August 2005 in the stream bed and riparian areas of Kalo`i and Hunehune gulches at and near the University of Hawaii, West O`ahu campus site.

Species listed by family	Common name	Status	Notes
	FLOWERING PLANTS		
	DICOTYLEDONES		
AIZOACEAE			
Trianthema portulacastrum L.	---	Nat.	(1)
AMARANTHACEAE			
Amaranthus spinosus L.	spiny amaranth	Nat.	(1)
Amaranthus sp.	indet. amaranth	Nat.	
ASTERACEAE (COMPOSITAE)			
Eclipta prostrata (L.) L.	false daisy	Nat.	
Tridax procumbens L.	coat buttons	Nat.	(1)
Xanthium strumarium L.	*kikiana*, cockleburr	Nat.	(1)
BIGNONIACEAE			
Tabebuia cf. *heterophylla* (A.P. de Cand.) Britton.	pink tecoma	Nat.	
CHENOPODIACEAE			
Atriplex suberectus Verd.	---	Nat.	(1)
CONVOLVULACEAE			
Ipomoea aquatica Forssk.	*ung choi*	Nat.	
Ipomoea obscura (L.) Ker-Gawl.	---	Nat.	(1)

Table 1 (continued).

Species listed by family	Common name	Status	Notes
CUCURBITACEAE			
Coccinia grandis (L.) Voigt	scarlet-fruited gourd	Nat.	(1)
EUPHORBIACEAE			
Ricinus communis L.	castor bean	Nat.	(1)
FABACEAE			
Canavalia cathartica Thours	*maunaloa*	Nat.	
Leucaena leucocephala (Lam.) deWit	*koa haole*	Nat.	(1)
Neonotonia wightii (Wight & Arnott) Lackey	---	Nat.	
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	*kiawe*	Nat.	(1)
Pithecelobium dulce (Roxb.) Benth.	*`opiuma*	Nat.	(1)
Senna cf. surrattensis (N.L. Burm.) H. Irwin & Barneby	*kolomana*	Nat.	
LAMIACEAE			
Leonotis nepetifolia (L.) R. Br.	lion's ear	Nat.	(1)
MELIACEAE			
Melia azedarach L.	Chinaberry tree	Nat.	(1)
ONAGRACEAE			
Ludwigia octovalvis (Jacq.) Raven	primrose willow	Nat.	
PORTULACACEAE			
Portulaca oleracea L.	pigweed	Nat.	(1)
STERCULIACEAE			
Waltheria indica L.	*`uhaloa*	Nat.	(1)
MONOCOTYLEDONES			
CYPERACEAE			
Cyperus alternifolius L.	umbrella sedge	Nat.	
Cyperus polystachyos Rottb.	---	**Ind.**	
POACEAE			
Brachiaria mutica (Forssk.) Stapf	California grass	Nat.	(1)
Cenchrus ciliaris L.	buffelgrass	Nat.	(1)
Chloris barbata (L.) Sw.	swollen fingergrass	Nat.	(1)
Leptochloa uninerva (K Presl.) Hitchc. & Chase	sprangletop	Nat.	
Panicum maximum Jacq.	Guinea grass	Nat.	(1)
TYPHACEAE			
Typha latifolia L.	common cattail	Nat.	

Legend to Table 1

STATUS = distributional status for the Hawaiian Islands:
- **end.** = endemic; native to Hawaii and found naturally nowhere else.
- **ind.** = indigenous; native to Hawaii, but not unique to the Hawaiian Islands.
- nat. = naturalized, exotic, plant introduced to the Hawaiian Islands since the arrival of Cook Expedition in 1778, and well-established outside of cultivation.
- orn. = exotic, ornamental or cultivated; plant not naturalized (not well-established outside of cultivation).
- **pol.** = Polynesian introduction before 1778.

NOTES:
(1) Species previously listed from the West Oahu Campus site by Char & Assoc., 2003.

All but one (*Cyperus polystachyos*) of the plants we observed during our survey growing in and around the drainages are introduced species that have become naturalized in this part of O`ahu and elsewhere in Hawai`i. Most of these species are weedy, ruderal species that thrive in disturbed habitats. Most species not previousl reported by Char & Assoc. (2003) are plants observed near water in the drainage system between H-1 and Kapolei Parkway. Some of these species (*Cyperus alternifolius*, *Brachiaria mutica*, *Typha latifolia, Ludwigia octovalvis*, and *Ipomoea aquatica*) are facultative wetland (occur usually in wetlands) or obligate wetland (occur almost always in wetlands) plants.

None of these plant species is listed as threatened or endangered, or otherwise would be considered rare or special by the State or Federal governments (DLNR, 1998; Federal Register, 1999a, b, 2001).

Aquatic Animals

A check-list of animals noted from the drainages visited during the survey is provided as Table 2. We observed aquatic animals only in the ponded water of Kalo`i Gulch at Kapolei Parkway (see Figure 4a). These animals may also be found in other areas with permanently or semi-permanently ponded water, such as the drainage basin at Mango Tree Road and Kapolei Parkway (Site 4), although none was observed during our survey.

Generally, the drainages throughout the project area do not provide suitable habitat for many native aquatic animals. Intermittent streams with ponded waters may provide adequate habitat for insects, including damselflies and dragonflies, such as the native dragonflies, *Anax junius* and *Pantala flavescens* that we observed in Kalo`i Gulch at Kapolei Parkway. Because the fishes and crustaceans native to Hawai`i are amphidromous (meaning they migrate to and from the ocean), they require perennial stream habitats with permanent or occasional connections to the ocean and can not live in Kalo`i Gulch.

None of these species is listed as threatened or endangered, or otherwise would be considered rare or special by the State or Federal governments (DLNR, 1998; Federal Register, 1999a, b, 2001).

Water Flow and Water Quality

Water was not flowing in the streams on the day of our survey and is likely to flow only immediately after a heavy rain storm. Due to the nature of the watershed (steep upper slopes, denuded vegetation, highly erodible soils), the runoff entering these gulches after a rain storm is likely to be turbid and carry a large load of suspended sediments. When flowing, the stream water may be high in nutrients as a result of

pesticides and fertilizers from the surrounding agricultural fields adhering to sediment particles and becoming suspended in the storm water.

Table 2. Listing of algae and animals observed in August 2005 in Kalo`i and Hunehune gulches across and near the University of Hawaii, West O`ahu campus site.

Species	Common name	Status	Abundance	Location
ALGAE				
STREPTOPHYTA	(green algae)			
ZYGNEMATACEAE				
indet. *Spirogyra* sp.			O	3
INVERTEBRATES				
ODONATA, AESCHNIDAE	(darner dragonflies)			
Anax junius	green darner, adult	**Ind.**	U	3
ODONATA, LIBULELLIDAE	(skimmer dragonflies)			
Crocothemis servilia	scarlet skimmer	Nat.	U	3
Orthemis ferruginea	roseate skimmer	Nat.	R	3
Pantala flavescens	globe skimmer	**Ind.**	U	3
VERTEBRATES				
VERTEBRATA, PICES	(fishes)			
POECILIIDAE				
Poecilia sp.	unident. poecillids	Nat	C	3
VERTEBRATA, AMPHIBIA	(frogs & toads)			
BUFONIDAE				
Bufo marinus	marine toad, tadpole	Nat.	C	3

Legend to Table 2

QC:
All species were observed in the field by aquatic biologists on August 18, 2005.
Status:
nat. - naturalized. An introduced or exotic species.
ind. - indigenous. A native species also found elsewhere in the Pacific.
end. - endemic - A native species found only in the Hawaiian Islands.
Abundance categories:
R – Rare – only one or two individuals seen.
U – Uncommon – several to a dozen individuals observed.
O – Occasional – regularly encountered, but in small numbers.
C – Common –Seen everywhere, although generally not in large numbers.
A – Abundant – found in large numbers and widely distributed.
P – Present – noted as occurring, but quantitative information lacking.
Distribution (where observed in project area):
1 – Farrington Highway and Kalo`i Gulch
2 – H-1 and Kalo`i Gulch
3 – Kapolei Parkway and Kalo`i Gulch
4 – Drainage basin at Mango Tree Road and Kapolei Parkway
5 – Hunehune Gulch and Farrington Highway

Project Assessment

Modifying drainages to improve flood control has the potential for altering nearshore ecosystems by contributing particulates of terrestrial origin. Straightening the gulches and lining them with concrete has the potential to transport nutrients and particulates quickly to the marine environment. The extent to which drainage modifications at the project site exacerbates sedimentation of the marine environment will depend upon the design of the drainage system and erosion controls implemented in the watershed. The development of the campus should adhere to the City and County of Honolulu's Storm Drainage Standards for developments larger than ten acres. Regular maintenance of the gulches and drainage basins should be undertaken, including inspection of facilities, silt and debris removal, and weed control.

Water quality impacts from development of the University of Hawai`i West O`ahu campus and modifications to Kalo`i and Hunehune gulches also must consider the potential of introducing urban pollutants into an area not previously subjected to runoff from roadways, parking lots, buildings, etc. Although modification of the drainage system may enhance the transfer of urban pollutants (such as heavy metals, petroleum products, and pesticides) to the marine environment, it is the urbanization that is responsible for the generation of these pollutants. Efforts that reduce the movement of particulates in runoff will be beneficial to reducing pollutants that are frequently associated with particulates in urban settings.

Other best management practices to reduce the introduction of non-point source pollution to the nearshore environment via Kalo`i Gulch are to include grassy swales, infiltration points, and separators in the design of the drainage system. A campus-wide program can be instituted to reduce the use of pollutants such as limiting fertilizer use, proper motor pool maintenance, and proper disposal of chemicals and other waste materials. Regular street cleaning and maintenance of irrigation systems will also reduce non-point source pollution.

During construction in the drainages, silt curtains should be used to prevent sediment released from the banks from entering the drainages. During construction of the campus, silt fencing should be erected to filter storm water runoff prior to discharge into the drainage ditch.

References Cited

AECOS, Inc. 1992. Untitled report prepared for 401 Certification application for The Ewa Villages Development, City & County of Honolulu, Department of Housing and Community Development (DHCD). Prep. for R.M. Towill Corp., Honolulu. AECOS Inc., Kailua. AECOS No. 722: 4 pp.

Bruner, P.L. 2005. Avifaunal and feral mammal field survey of lands involved in the University of Hawaii - West O`ahu (UH West O`ahu) project, Kapolei, Oahu, Hawaii. Prep. for: PBR-Hawaii. 9 pp.

Char and Associates. 2003. Botanical survey University of Hawai`i West O`ahu East Kapolei, `Ewa District, O`ahu. Prep. for: PBR-Hawaii. 9 pp.

Char, W. P., and N. Balakrishnan. 1979. `Ewa Plains botanical survey. Prep. for U.S. Dept. Interior, Fish and Wildlife Service. University of Hawaii, Department of Botany. Contract No. 14-16-0001-78171: 119 pp.

Federal Register. 1999a. Department of the Interior, Fish and Wildlife Service, Endangered and Threatened Wildlife and Plants. 50CFR 17:11 and 17:12 – December 3, 1999.

_____. 1999b. Department of the Interior, Fish and Wildlife Service, 50 CFR 17. Endangered and Threatened Wildlife and Plants. Endangered and Threatened Wildlife and Plants; Review of Plant and Animal Taxa that are Candidates or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Recycled Petitions, and Annual Description of Progress on Listing Actions. *Federal Register*, 64 (205 (Monday, October 25, 1999)): 57534-57547.

_____. 2001. Department of the Interior, Fish and Wildlife Service, 50 CFR 17. Endangered and Threatened Wildlife and Plants. Notice of Findings on Recycled Petitions. *Federal Register*, 66 No. 5 (Monday, January 8, 2001): 1295 – 1300.

Hawaii Cooperative Park Service Unit. 1990. Hawaii stream assessment. A preliminary appraisal of Hawaii's stream resources. Prep. for State of Hawaii, Commission on Water Resource Management. National Park Service, Hawaii Cooperative Park Service Unit, Rept. No. R84: 294 pp.

Hawaii Department of Land and Natural Resources (DLNR). 1998. Indigenous Wildlife, Endangered And Threatened Wildlife And Plants, And Introduced Wild Birds. Department of Land and Natural Resources. State of Hawaii. Administrative Rule §13-134-1 through §13-134-10, dated March 02, 1998.

Neal, M. C. 1965. *In Gardens of Hawaii*. Vol. Bernice P. Bishop Museum Spec. Publ. 50. Bishop Museum Press. 924 pp.